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PENSOFT

New records and distribution map of Gold-striped Frog, *Lithodytes lineatus* (Schneider, 1799) (Anura, Leptodactylidae), in an ecotonal zone in Mato Grosso, Brazil

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Abstract

Lithodytes lineatus (Schneider, 1799) is a small, litter-dwelling frog widely distributed in the Amazon Ecoregion and some transitional areas between the Amazon and Cerrado. Here we report seven new records of this species in a transitional zone between Amazon, Chiquitano Dry Forest and Cerrado ecoregions in the state of Mato Grosso, Brazil. These are the southernmost records of the species, expanding its distribution in 320 km from the nearest record in Bolivia.

Keywords

Amphibians, Cerrado-Amazon ecotone, Chiquitano Dry Forest Ecoregion

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Introduction

The family Leptodactylidae has 220 currently recognized species distributed in the Neotropics, with 161 of them occurring in Brazilian territory (Segalla et al. 2019; Frost 2020). In Brazil, the family is represented by three subfamilies, with Leptodactylinae representing the most diverse taxon and containing 75 species allocated to the genera *Adenomera* (16 spp.), *Hydrolaetare* (3 spp.), *Leptodactylus* (55 spp.), and *Lithodytes* (1 sp.) (Segalla et al. 2019).

Lithodytes Fitzinger, 1843 is a monotypic genus which was has previously considered a subgenus of *Leptodactylus* (Frost et al. 2006). It was elevated to a full genus by Pyron and Wiens (2011). *Lithodytes lineatus* (Schneider, 1799) is a small litter-dwelling frog (snout–vent length [SVL] 34–45 mm in males and 44–56 mm in females) which presents a singular association with colonies of leaf-cutting ants of the genus *Atta* and uses the colonies as shelter and a breeding location (Rodriguez and

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Duellman 1994; Lima et al. 2006; Bernarde 2007; Barros et al. 2016). *Lithodytes lineatus* occurs in the Amazon region of Bolivia, Brazil, Ecuador, French Guiana, Peru, Suriname, and Venezuela (Harvey et al. 1998; La Marca et al. 2010; Barrios-Amorós et al. 2019; Frost 2020).

In Brazil, *L. lineatus* has been reported for the states of Amazonas (Lima et al. 2006; França and Venâncio 2010), Acre (Bernarde et al. 2011; 2013), Pará (Bernardo et al. 2012), Rondônia (Bernarde 2007; Bernarde and Macedo 2008; Bernarde and Kokubum 2009), the northern portion of Mato Grosso (São Pedro et al. 2009; Noronha et al. 2015) and Maranhão (Freitas et al. 2014). There are also records of this species from transition zones between the Amazon and Cerrado ecoregions (Tropical and Subtropical Moist Broadleaf Forests and Tropical and Subtropical Grasslands, Savannas and Shrublands biomes, respectively) in the states of Mato Grosso (Bitar et al. 2012) and Tocantins (Cintra et al. 2014; Thaler et al. 2020), and in the Chiquitano Dry Forest Ecoregion (Tropical and Subtropical Dry Broadleaf Forests biome) in Bolivia (Harvey et al. 1998).

In the present study, we report seven new records of *L. lineatus* from Mato Grosso state, Brazil, where we found it in the Chiquitano Dry Forest Ecoregion, which is a transition zone of the Amazon and Cerrado. Additionally, we provide an updated distribution map with the new records and localities from the literature which lie outside the distribution of the species as shown by La Marca et al. (2010).

Methods

We collected the specimens using 126 sets of pitfall traps in 21 forest fragments from 2002 to 2004. One record was based on a specimen housed in the Amphibian Collection of Museu Nacional, Universidade Federal do Rio de Janeiro, state of Rio de Janeiro, Brazil (MNRJ). The fragments are inserted in a pasture matrix, in the microbasins of the Jauru and Cabaçal rivers, tributaries of the Paraguay river, in southwestern Mato Grosso. The local vegetation is classified as Seasonal Submontane Semideciduous Forest and is part of the Chiquitano Dry Forest Ecoregion (Olson et al. 2001; IBGE 2004; Power et al. 2016). According to the Köppen classification, the climate is Aw type with average temperatures ranging from 24 to 26 °C and precipitation from 1300 to 1600 mm annually (Alvares et al. 2013).

In each fragment inspected, we installed six series of pitfall traps (Cechin and Martins 2001). The first series was installed on the pasture, 50 m from the edge of the fragment. The second on the edge and the next, successively, every 50 m inside the fragment until 200 m. Each series consisted of five buckets, each with a volume of 24 L, buried in the ground. The buckets were spaced 10 m apart in a line and connected by an 80 cm high plastic canvas guide fence. We opened the trap sets for 10 consecutive days in each forest fragment and inspected the trap sets daily each morning.

The specimens were euthanized with the administration of topical lidocaine gel (2%) inside the mouth or ventral and inguinal region. We housed the voucher specimens in the Coleção Herpetológica do Centro de Pesquisa de Limnologia, Biodiversidade, Etnobiologia do Pantanal (CELBE) of the Universidade do Estado de Mato Grosso. The collection licenses were granted by Instituto Brasileiro de Meio Ambiente e dos Recursos Naturais Renováveis (no. 033/02, 004/03, and 057/04).

The specimens of *L. lineatus* were identified based on Rodriguez and Duellman (1994) and Lima et al. (2006). We measured the SVL of the specimens using digital calipers (Digimess 100.176BL).

Results

Lithodytes lineatus (Schneider, 1799)

We collected six individuals of *L. lineatus* in Chiquitano Dry Forest, transition zone of the Amazon Ecoregion with the Cerrado, in the municipalities of Araputanga, Indiavaí, Jauru, and São José dos Quatro Marcos southwestern region of the Mato Grosso state. Among the six individuals, only one (MZT 0160) was collected at the fragment edge, whereas the others were collected at least 50 m into the forest fragment, with no records in the pasture matrix. We collected one individual in the area of influence of a small hydroelectric power plant in the municipality of Jauru. Four records were made during the rainy season and two during the dry season. The seventh record was obtained from the Amphibian Collection of Museu Nacional, Universidade Federal do Rio de Janeiro, state of Rio de Janeiro, Brazil (MNRJ 87248) collected in the municipality of Lambari D'Oeste, Mato Grosso in 2013 (Fig. 1).

New records. BRAZIL • 1 adult ♀, SVL = 48.4 mm; Mato Grosso, Araputanga municipality, Jauru river basin, Seasonal Semideciduous Submontane Forest, Chiquitano Dry Forest Ecoregion, Amazon rainforest and Cerrado Ecotone; 15°23′21″S, 058°24′54″W; 310 m a.s.l.; 11 Feb. 2002; Dionei José da Silva and Manoel dos Santos-Filho leg.; collected at the edge of a 97 ha fragment; MZT 0160. • 1 adult ♀, SVL = 47.62 mm; Mato Grosso, São José dos Quatro Marcos municipality, Cabaçal river basin, Seasonal Semideciduous Submontane Forest, Chiquitano Dry Forest Ecoregion, Amazon rainforest and Cerrado Ecotone; 15°22′37″S, 058° 03′50″W; 176 m a.s.l.; 25 Jan. 2003; Dionei José da Silva and Manoel dos Santos-Filho leg.; collected 100 m from the edge of a 152 ha fragment; MZT 0256 (Fig. 2). • 1 unidentified sex, SVL = 44.40 mm; Mato Grosso, Jauru municipality, Jauru river basin, Chiquitano Dry Forest Ecoregion, Amazon rainforest and Cerrado Ecotone; 15°12′42″S, 058°43′54″W; 388 m a.s.l.; 07 May 2003; Dionei José da Silva and Manoel dos Santos-Filho leg.; collected in the area of influence of the Jauru Hydroelectric Power Plant; MZT 0482. • 1 juvenile SVL = 27.71 mm; Mato Grosso, São José dos

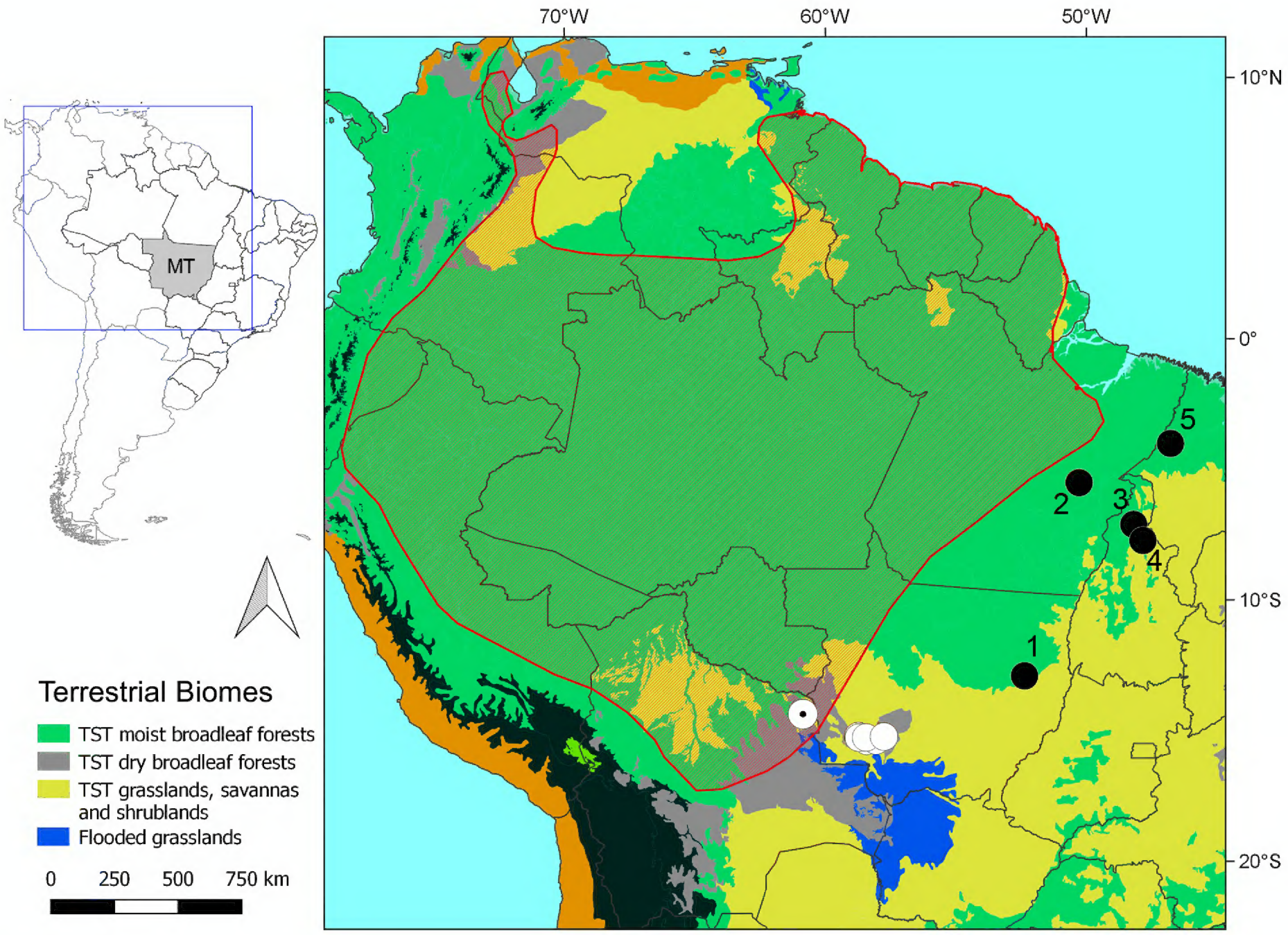

Figure 1. Distribution map of *Lithodytes lineatus* in South America. Red polygon: distribution of the species according to La Marca et al. (2010). White circles: new records in Araputanga, Jauru, Lambari D'Oeste, Indiavaí, and São José dos Quatro Marcos municipalities, southwestern Mato Grosso. White circle with dot: nearest previous record, in Noel Kempff Mercado National Park, in Bolivia (Harvey et al. 1998). Black circles: other records from the literature outside distribution of the species according to La Marca et al. (2010) and in Amazon–Cerrado transitional areas: (1) Querência municipality (MT) (Bitar et al. 2012), (2) Marabá and São Félix do Xingu municipalities (Pará) (Bernardo et al. 2012), (3) Araguaína municipality (Tocantins) (Thaler et al. 2020); (4) Filadélfia municipality (Tocantins) (Cintra et al. 2014), and (5) Bom Jardim municipality (Maranhão) (Freitas et al. 2013). Abbreviations: MT = Mato Grosso state; and TST = Tropical and Sub-Tropical. The terrestrial biomes are adapted from Olson et al. (2001).

Quatro Marcos municipality, Cabaçal river basin, Seasonal Semideciduous Submontane Forest, Chiquitano Dry Forest Ecoregion, Amazon rainforest and Cerrado Ecotone; 15°22′37″S, 058°03′50″W; 176 m a.s.l.; 28 Aug. 2003; Dionei José da Silva and Manoel dos Santos-Filho leg.; collected 200 m from the edge of a 152 ha fragment; MZT 0493. • 1 adult ♀, SVL = 46.17 mm; Mato Grosso, Indiavaí municipality, Jauru river basin, Seasonal Semideciduous Submontane Forest, Chiquitano Dry Forest Ecoregion, Amazon rainforest and Cerrado Ecotone; 15°16′13″S, 058°42′46″W; 247 m a.s.l.; 24 Jan. 2004; Dionei José da Silva and Manoel dos Santos-Filho leg.; collected 200 m from the edge of a 100 ha fragment; MZT 0640. • 1 juvenile, SVL = 25.07 mm; Mato Grosso, Araputanga municipality, Jauru river basin, Seasonal Semideciduous Submontane Forest, Chiquitano Dry Forest Ecoregion, Amazon rainforest and Cerrado Ecotone; 15°15′48″S, 058°26′17″W; 334 m a.s.l.; 25 Jan. 2004; Dionei José da Silva and Manoel dos Santos-Filho leg.; collected 200 m from the edge of a 4,739 ha fragment; MZT 0812. • 1 unidentified sex; Mato Grosso, Lambari D'Oeste municipality, Jauru river basin, Chiquitano Dry Forest Ecoregion, Amazon and Cerrado Ecotone; 15°13′52.00″S, 057°45′02.02″W; 24 Nov. 2013; collector not specified; MNRJ 87248.

Identification. We identified the specimens as *L. lineatus* based on the following main diagnostic characters. The dorsum skin is slightly spiculated and the color is black with two dorsolateral, yellow or cream-colored bands (Fig. 2A) that extends from the snout to the flanks (Rodriguez and Duellman 1994; Lima et al. 2006); the ventral surface (Fig. 2B) is smooth and grayish-brown with cream-colored spots (Rodriguez and Duellman 1994). Large red spots are present in the inguinal and axillary regions, and even on the thighs (Rodriguez and Duellman 1994). The legs are brown with transverse bars on their posterior part (Lima et al. 2006).

According to Rodriguez and Duellman (1994), juvenile *L. lineatus* can be misidentified with the dendrobatid frog *Allobates femoralis* (Boulenger, 1884). However, *A. femoralis* differs from *L. lineatus* in having a half-moon-shaped red spot on the thigh, a yellow spot at the base of the arm, a white sideband that extends from the labial to the inguinal regions, and a white belly with black

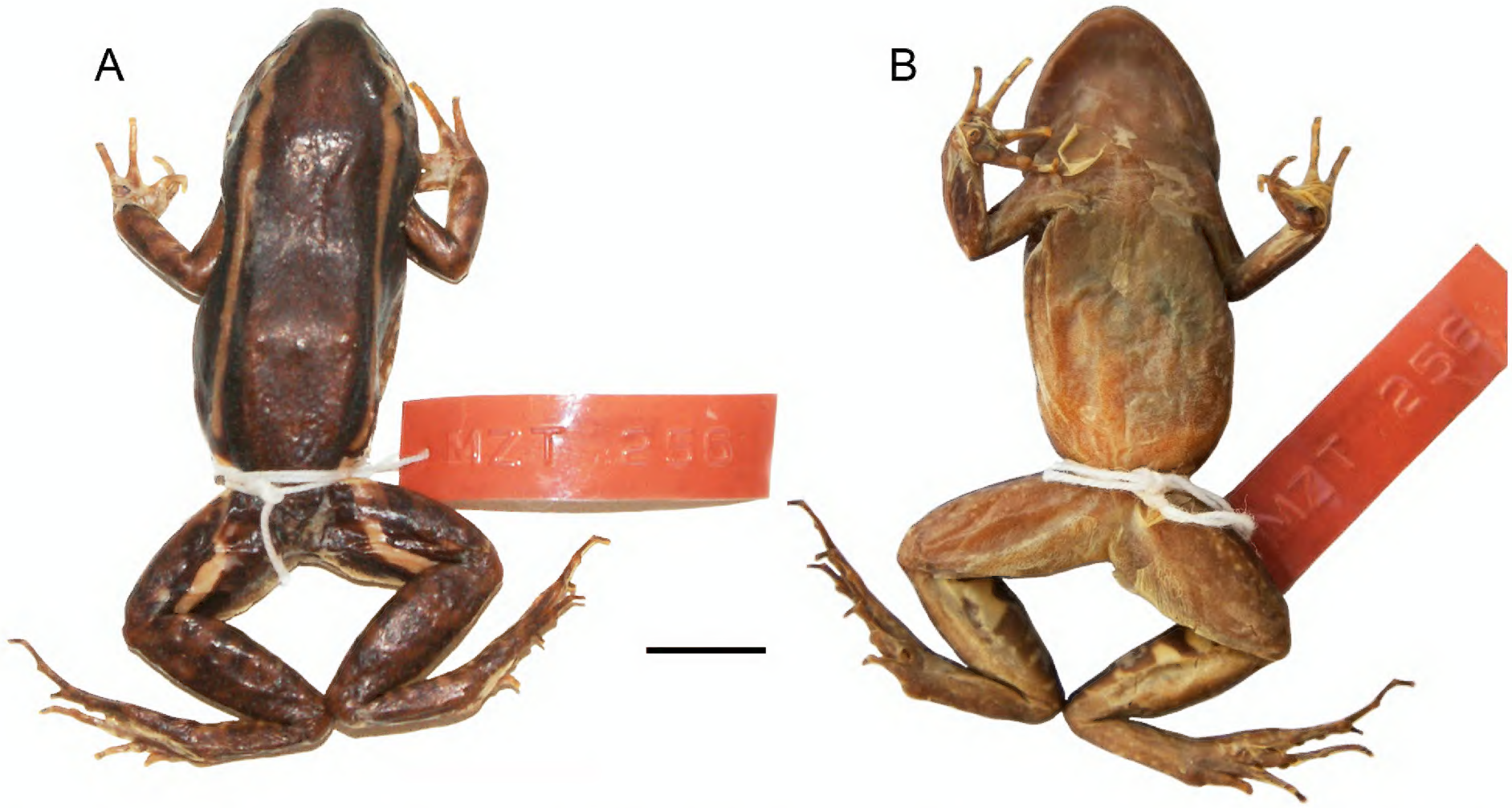

Figure 2. *Lithodytes lineatus* from the municipality of São José dos Quatro Marcos, southwestern Mato Grosso, Brazil (MZT 0256). **A.** Dorsal view. **B.** Ventral view. Scale bar = 1 cm.

spots (Rodriguez and Duellman 1994; Lima et al. 2006; Amézquita et al. 2009).

Discussion

Lithodytes lineatus is widely distributed along the Amazon, and it is also recorded in transition zones of the Amazon and Cerrado ecoregions (Barrio-Amorós et al. 2019; Frost 2020; Thaler et al. 2020). Although this species has been recorded from Mato Grosso, until now it was only known from the typically Amazonian areas in the northern part of the state (São-Pedro et al. 2009; Noronha et al. 2015) and from transition zones in the northeastern of the state (Bitar et al. 2012). In the present study we report new records in the Chiquitano Dry Forest Ecoregion in southwestern Mato Grosso.

Our new records of *L. lineatus* from the municipalities of Jauru, Indiavaí, Lambari D'Oeste, Araputanga, and São José dos Quatro Marcos extend this species' distribution by 320 km from the previously known record in Noel Kempff Mercado National Park, eastern Bolivia (Harvey et al. 1998). The record from Araputanga represents the southernmost occurrence of this species (Fig. 1). Our new records expand the known distribution of *L. lineatus* to the south outside of the the species' distribution according to La Marca et al. (2010).

We found specimens of *L. lineatus* only at the edge and within the forest fragments, but not in adjacent pastures, where we also placed traps. Our results reinforce the preferences of this species for forest environments and the structures made available by the forest, such as the presence of litter (Rodriguez and Duellman 1994; Bernarde and Macedo 2008; Bernarde and Kokubum 2009). In this sense, the conversion of native vegetation to areas of crops and pasture in the region of the new records (Silva et al. 2014; Fermiano et al. 2020) may represent an important local threat to the species, as also observed by Bernarde and Kokubum (2009). In addition, one of the records (MZT 0482) occurred within the area influenced by the Jauru Hydroelectric Power Plant, which reinforces the need for greater attention to the conservation of the adjacent forest remnants as a way to guarantee the local viability of this species.

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Authors' contribution

DJS, MSF collected the specimens. MON visited the Museu Nacional. ECF and VDSA identified the specimens. ECF, VDSA, ODS wrote the manuscript and MON and DJS reviewed the manuscript text and complemented it with additional information.

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